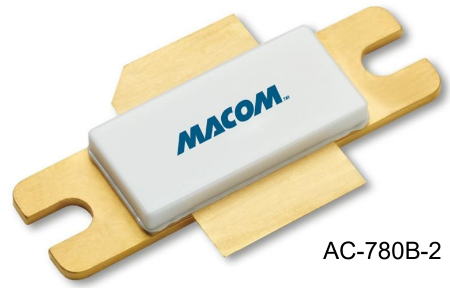
GaN Amplifier 50 V, 700 W Pulsed[3]
1.0 - 1.1 GHz

Features
- Optimized for Avionics Applications
- Pulsed Operation: 700 W Output Power
- Internally Pre-Matched
- 260°C Reflow Compatible
- 50 V Operation
- 100% RF Tested
- RoHS* Compliant



AC-780B-2

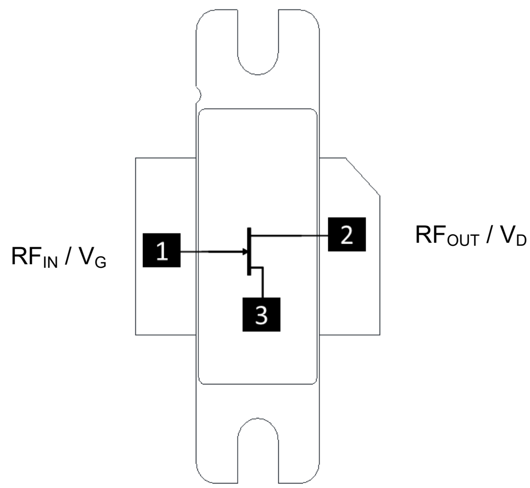
Description
The MAGX-101011-700E00 is a GaN on Si HEMT D-mode amplifier designed for avionics applications with 700 W peak power and optimized for 1.0 - 1.1 GHz extended pulsed signal operation. This device supports pulsed and linear operation with peak output power levels of at least 700 W (58.45 dBm) in an air cavity ceramic package.

Typical Performance:
- V_{DS} = 50 V, I_{DQ} = 200mA, T_C = 25°C. Measured under pulsed[3] load-pull at 2.5 dB Compression

Frequency (GHz)	Output Power[1] (dBm)	Gain[2] (dB)	η_D[2] (%)
1.03	60	19.3	73
1.06	59.9	19	74
1.09	59.8	19.1	74

1. Load impedance tuned for maximum output power.
2. Load impedance tuned for maximum drain efficiency.
3. Pulse details: 100 µs pulse width, 10% Duty Cycle

Functional Schematic



Pin Configuration

Pin #	Pin Name	Function
1	RF_{IN} / V_G	RF Input / Gate
2	RF_{OUT} / V_D	RF Output / Drain
3	Flange[4]	Ground / Source

4. The flange on the package bottom must be connected to RF, DC and thermal ground.

Ordering Information

Part Number	Package
MAGX-101011-700E00	Bulk Quantity
MAGX-101011-700ET0	Tape and Reel
MAGX-1A1011-700E00	Sample Board

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

RF Electrical Characteristics: T_C = 25°C, V_{DS} = 50 V, I_{DQ} = 200 mA
Note: Performance in MACOM Evaluation Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Small Signal Gain	Pulsed[3], 1.09 GHz	G_{SS}	-	19.3	-	dB
Saturated Output Power	Pulsed[3], 1.09 GHz, 2.5dB Gain Compression	P_{SAT}	-	58.7	-	dBm
Drain Efficiency at Saturation	Pulsed[3], 1.09 GHz, 2.5dB Gain Compression	η_{SAT}	-	70	-	%
Gain Variation (-40°C to +85°C)	Pulsed[3], 1.09 GHz, P_{OUT} = 58.45 dBm	ΔG	-	0.03	-	dB/°C
Power Variation (-40°C to +85°C)	Pulsed[3], 1.09 GHz, 2.5dB Gain Compression	ΔP2.5dB	-	0.01	-	dB/°C
Power Gain	Pulsed[3], 1.09 GHz, P_{OUT} = 58.45 dBm	G_P	-	17.9	-	dB
Drain Efficiency	Pulsed[3], 1.09 GHz, P_{OUT} = 58.45 dBm	η	-	67	-	%
Input Return Loss	Pulsed[3], 1.09 GHz, P_{OUT} = 58.45 dBm	IRL	-	-15	-	dB
Ruggedness: Output Mismatch	All phase angles	Ψ	VSWR = 10:1, No Device Damage			

RF Electrical Specifications: T_A = 25°C, V_{DS} = 50 V, I_{DQ} = 200 mA
Note: Performance in MACOM Production Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Gain	Pulsed[3], 1.09 GHz, P_{OUT} = 58.45 dBm	G_P	16.7	17.9	-	dB
Drain Efficiency	Pulsed[3], 1.09 GHz, P_{OUT} = 58.45 dBm	η	62	67	-	%
Input Return Loss	Pulsed[3], 1.09 GHz, P_{OUT} = 58.45 dBm	IRL	-	-15	-7.5	dB

DC Electrical Characteristics: T_A = 25°C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Drain-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 130 V	I_{DLK}	-	-	116	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 0 V	I_{GLK}	-	-	116	mA
Gate Threshold Voltage	V_{DS} = 50 V, I_D = 116 mA	V_T	-2.6	-2.2	-	V
Gate Quiescent Voltage	V_{DS} = 50 V, I_D = 200 mA	V_{GSQ}	-2.4	-2.15	-1.4	V
On Resistance	V_{GS} = 2 V, I_D = 870 mA	R_{ON}	-	0.05	-	Ω
Maximum Drain Current	V_{DS} = 7 V, pulse width 300 μs	$I_{D, MAX}$	-	67.6	-	A

Absolute Maximum Ratings[5,6,7,8,9]

Parameter	Absolute Maximum
Drain Source Voltage, V_{DS}	130 V
Gate Source Voltage, V_{GS}	-10 to 3 V
Gate Current, I_G	116 mA
Storage Temperature Range	-65°C to +150°C
Case Operating Temperature Range	-40°C to +85°C
Channel Operating Temperature Range, T_{CH}	-40°C to +225°C
Absolute Maximum Channel Temperature	+250°C

5. Exceeding any one or combination of these limits may cause permanent damage to this device.
6. MACOM does not recommend sustained operation above maximum operating conditions.
7. Operating at drain source voltage V_{DS} < 55 V will ensure MTTF > 1 x 10^7 hours.
8. Operating at nominal conditions with T_{CH} ≤ 225°C will ensure MTTF > 1 x 10^7 hours.
9. MTTF may be estimated by the expression MTTF (hours) = A $e^{[B + C/(T+273)]}$ where *T* is the channel temperature in degrees Celsius, *A* = 3.686, *B* = -35.00, and *C* = 25,416.

Thermal Characteristics[10]

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance using Finite Element Analysis	V_{DS} = 50 V, T_C = 85°C, T_{CH} = 225°C	R_θ(FEA)	0.41	°C/W
Thermal Resistance using Infrared Measurement of Die Surface Temperature	V_{DS} = 50 V, T_C = 85°C, T_{CH} = 225°C	R_θ(IR)	0.33	°C/W

10. Case temperature measured using thermocouple embedded in heat-sink. Contact local applications support team for more details on this measurement.

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

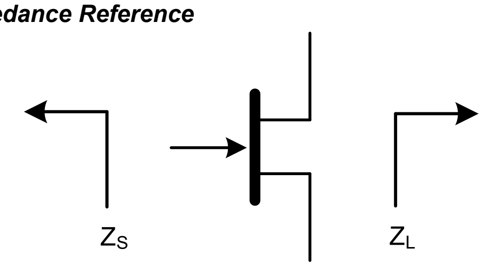
Gallium Nitride Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1C, CDM Class C3 devices.

Pulsed[3] Load-Pull Performance
Reference Plane at Device Leads

Frequency (GHz)	Z_{SOURCE} (Ω)	Maximum Output Power V_{DS} = 50 V, I_{DQ} = 200 mA, T_C = 25°C, P2.5dB					
		Z_{LOAD}[11] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM (°)
1.03	0.43 - j1.25	0.54 + j0.02	17.7	60	1000	63.8	-6.7
1.06	0.52 - j1.42	0.53 + j0.02	17.8	59.9	977.2	65.5	-8.3
1.09	0.59 - j1.43	0.57 + j0.06	17.7	59.8	955	65.5	-11.5

Frequency (GHz)	Z_{SOURCE} (Ω)	Maximum Drain Efficiency V_{DS} = 50 V, I_{DQ} = 200 mA, T_C = 25°C, P2.5dB					
		Z_{LOAD}[12] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM (°)
1.03	0.50 - j1.42	0.63 + j0.48	19.3	58.2	660.7	73	-9
1.06	0.83 - j1.54	0.67 + j0.45	19	58.4	691.8	74	-11.2
1.09	1.10 - j1.58	0.62 + j0.43	19.1	57.9	616.6	74	-15.3

Impedance Reference

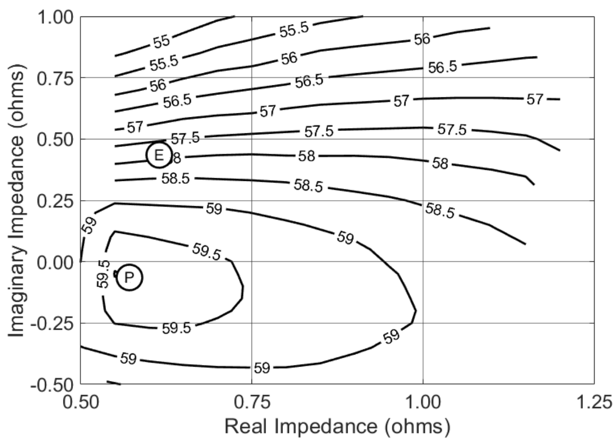


Z_{SOURCE} = Measured impedance presented to the input of the device at package reference plane.
Z_{LOAD} = Measured impedance presented to the output of the device at package reference plane.

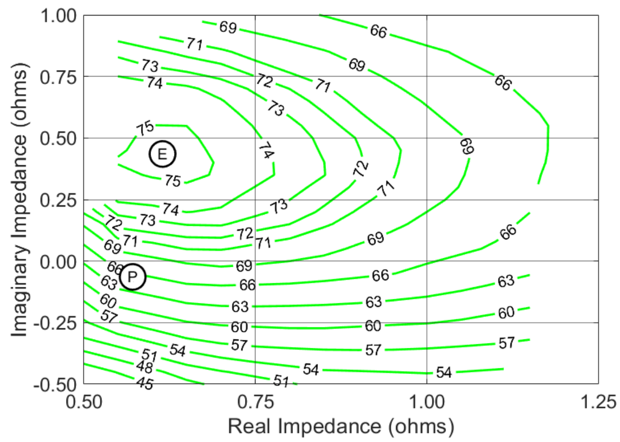
11. Load Impedance for optimum output power.
12. Load Impedance for optimum efficiency.

Pulsed³ Load-Pull Performance
1.09 GHz

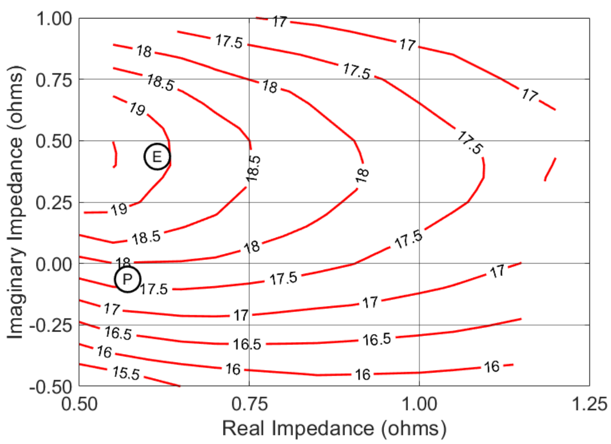
P2.5dB Loadpull Output Power Contours (dBm)



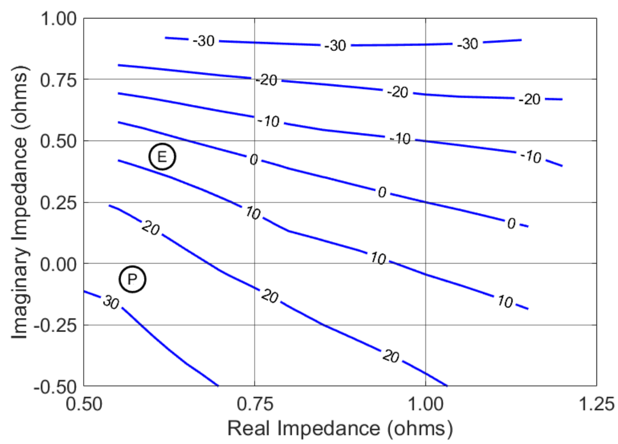
P2.5dB Loadpull Drain Efficiency Contours (%)



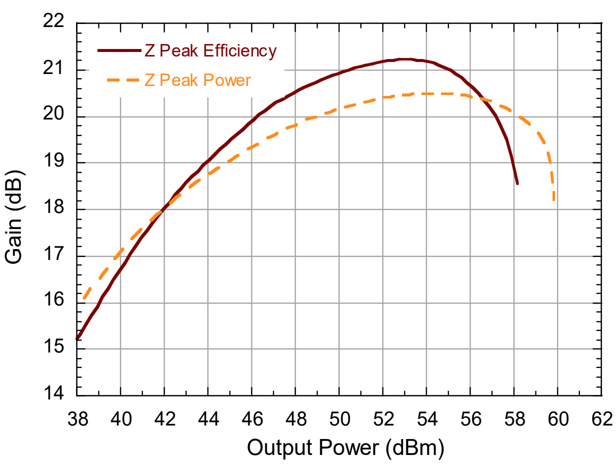
P2.5dB Loadpull Gain Contours (dB)



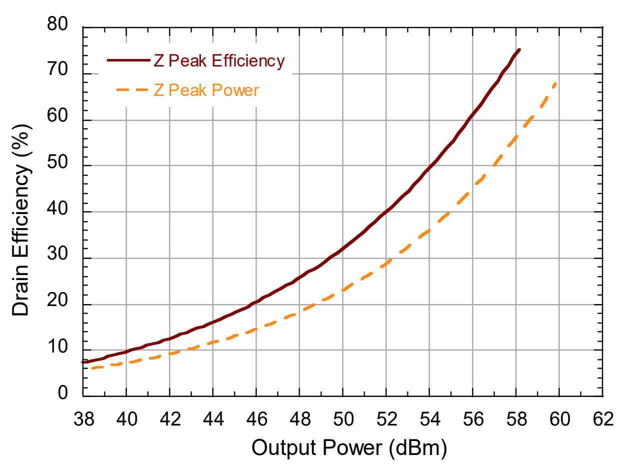
P2.5dB Loadpull AM/PM Contours (°)



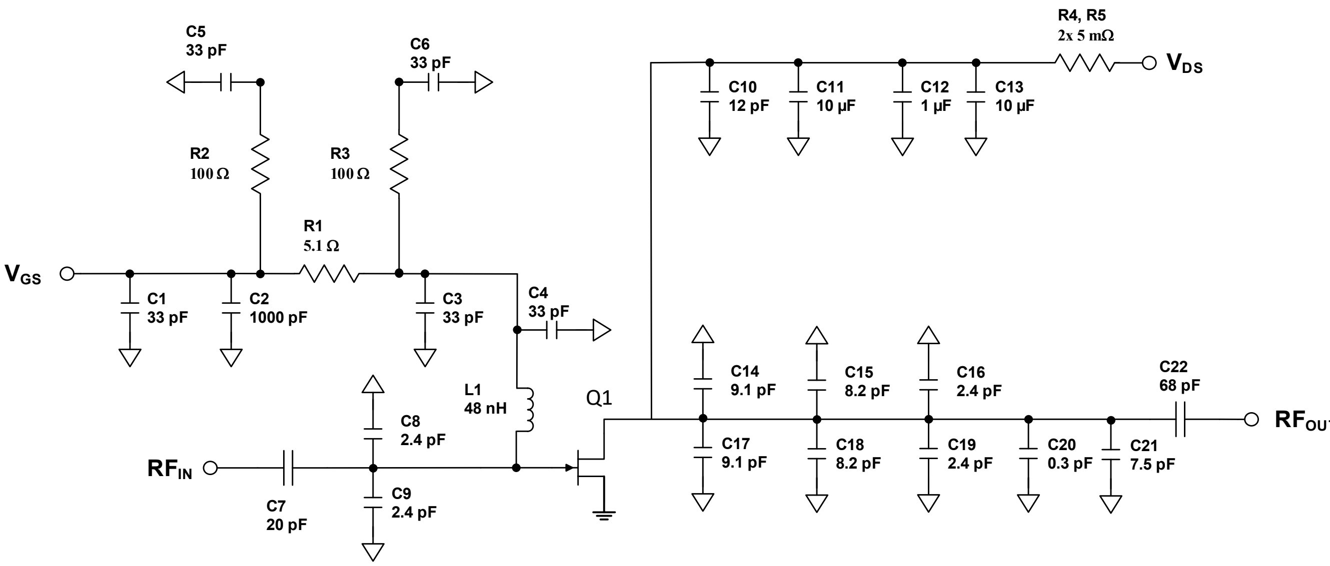
Gain vs. Output Power



Drain Efficiency vs. Output Power



Evaluation Test Fixture and Recommended Tuning Solution 1.03 - 1.09 GHz



Description

Parts measured on evaluation board (25-mil thick RO3006). Matching is provided using a combination of lumped elements and transmission lines as shown in the simplified schematic above. Recommended tuning solution component placement, transmission lines, and details are shown on the next page.

Bias Sequencing

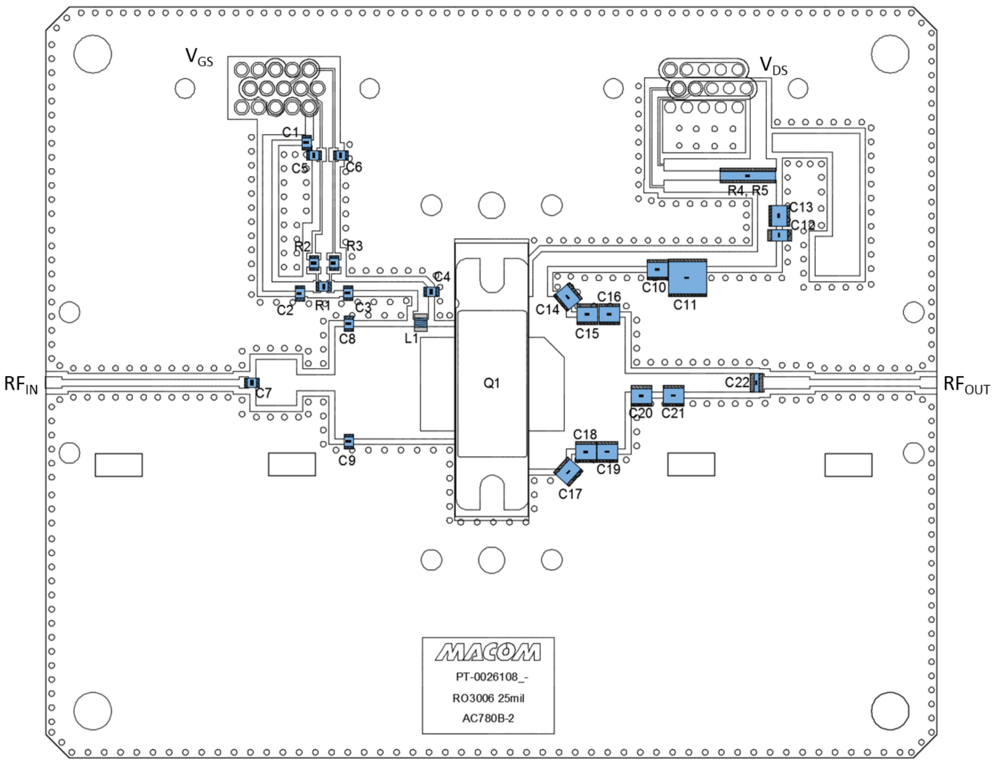
Turning the device ON

1. Set V_{GS} to pinch-off (V_P), typically -5 V.
2. Turn on V_{DS} to nominal voltage (50 V).
3. Increase V_{GS} until the quiescent drain current I_{DQ} is reached, typically 200 mA.
4. Apply RF power to desired level.

Turning the device OFF

1. Turn the RF power OFF.
2. Decrease V_{GS} down to V_P.
3. Decrease V_{DS} down to 0 V.
4. Turn off V_{GS}.

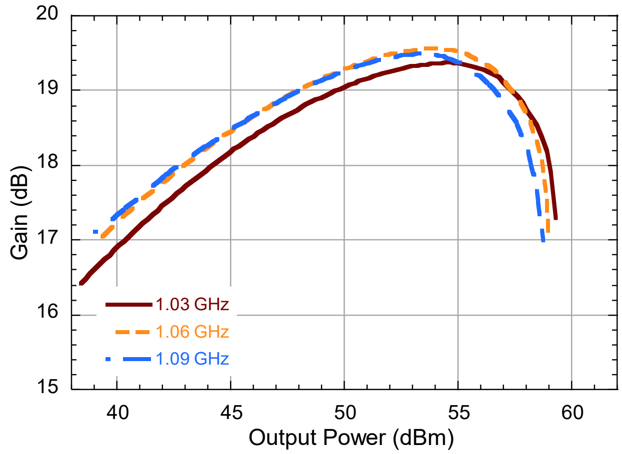
Evaluation Test Fixture and Recommended Tuning Solution 1.03 - 1.09 GHz



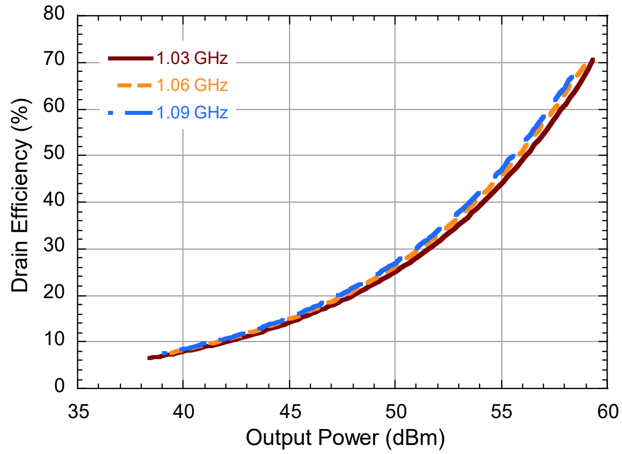
Reference Designator	Value	Tolerance	Manufacturer	Part Number
C1, C3, C4, C5, C6	33 pF	+/- 5 %	PPI	0805N330JW251X
C2	1000 pF	+/- 0.1 pF	Murata	GRM219R72A102JA01D
C7	20 pF	+/- 5 %	PPI	0805N200JW251X
C8, C9	2.4 pF	+/- 0.1 pF	PPI	0805N2R4BW251X
C10	12 pF	+/- 5 %	PPI	1111N120FW501XT
C11	10 µF	+/- 20 %	TDK	C5750X7S2A106M230KB
C12	1 µF	+/- 10 %	Murata	GRM31CR72105KA01L
C13	10 µF	+/- 10 %	Murata	GRM32EC72A106KE05L
C14, C17	9.1 pF	+/- 0.1 pF	PPI	1111N9R1FW501XT
C15, C18	8.2 pF	+/- 0.1 pF	PPI	1111N8R2FW501XT
C16, C19	2.4 pF	+/- 0.1 pF	PPI	1111N2R4FW501XT
C20	0.3 pF	+/- 0.1 pF	PPI	1111N0R3FW501XT
C21	7.5 pF	+/- 0.1 pF	PPI	1111N7R5FW501XT
C22	68 pF	+/- 5 %	PPI	0708N680GW501T
R1	5.1 Ω	+/- 1 %	Vishay	CRCW08055R10FKEA
R2, R3	100 Ω	+/- 1 %	Vishay	CRCW0805100RFKEAC
R4, R5	5 mΩ	+/- 1 %	Susumu	RL7520WT-R005-F
L1	48 nH	+/- 5 %	Coilcraft	0805HQ-48NXJLB
Q1	MACOM GaN Power Amplifier			MAGX-101011-700E00
PCB	RO3006, 25 mil, 0.5 oz. Cu, Au Finish			

Typical Performance Curves as Measured in the 1.03 - 1.09 GHz Evaluation Test Fixture:
Pulsed³ 1.09 GHz, V_{DS} = 50 V, I_{DQ} = 200 mA, T_C = 25°C
Unless Otherwise Noted

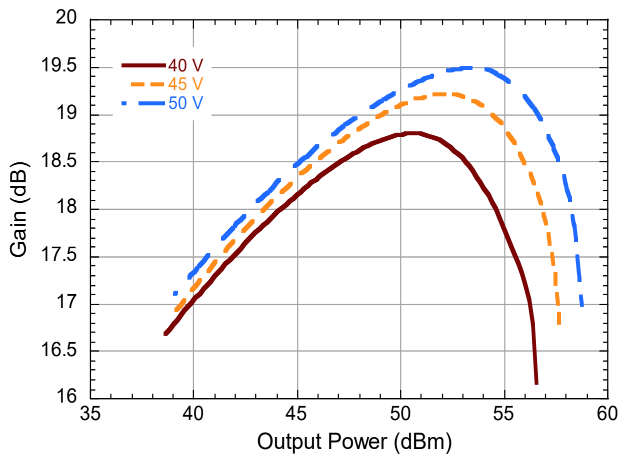
Gain vs. Output Power and Frequency



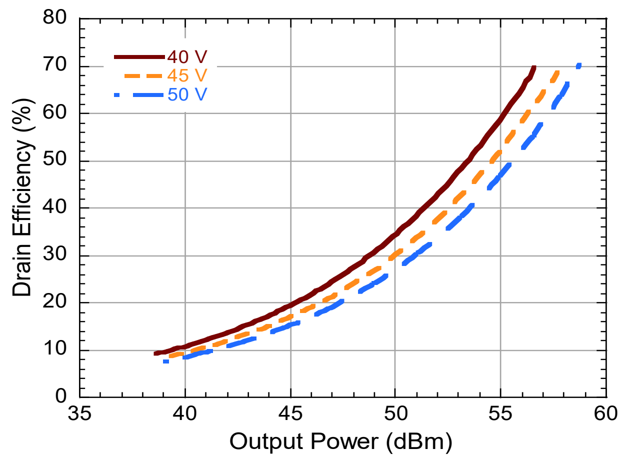
Drain Efficiency vs. Output Power and Frequency



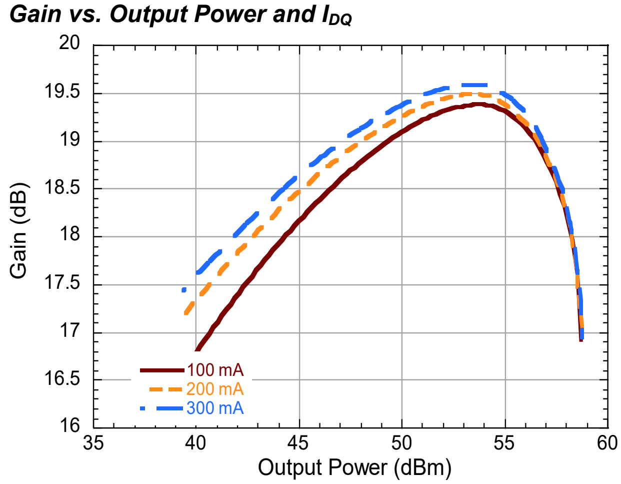
Gain vs. Output Power and V_{DS}



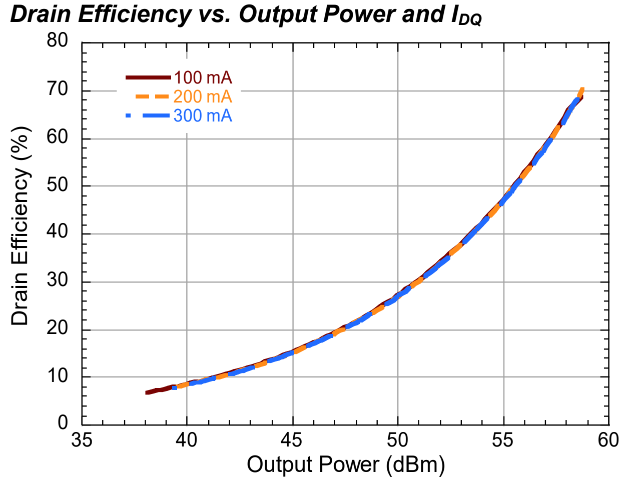
Drain Efficiency vs. Output Power and V_{DS}



Gain vs. Output Power and I_{DQ}

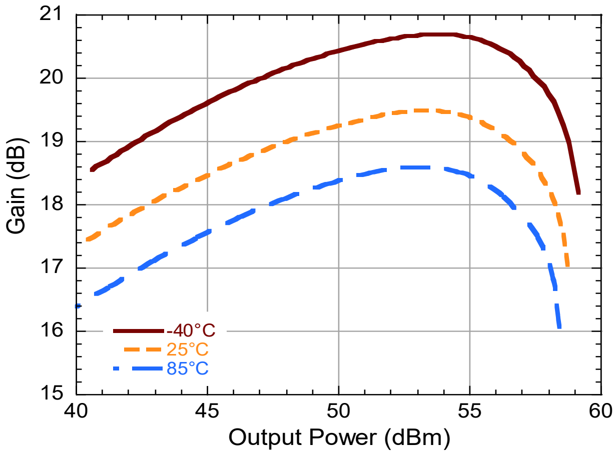


Drain Efficiency vs. Output Power and I_{DQ} ***Ef***

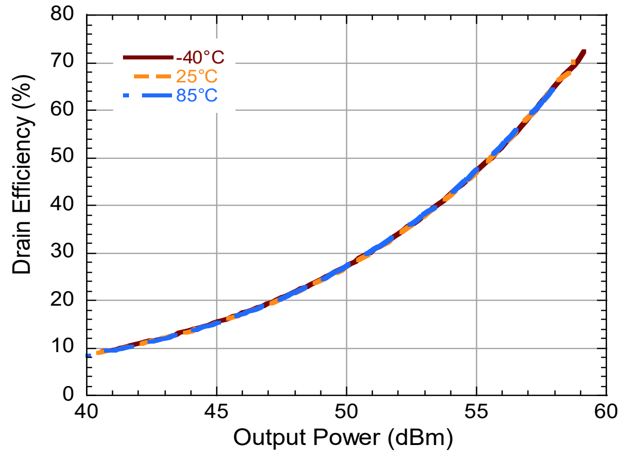


Typical Performance Curves as Measured in the 1.03 - 1.09 GHz Evaluation Test Fixture: Pulsed[3] 1.09 GHz, V_{DS} = 50 V, I_{DQ} = 200 mA, T_C = 25°C Unless Otherwise Noted

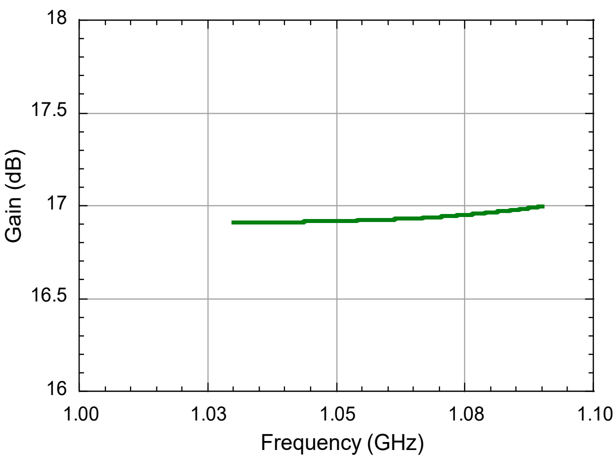
Gain vs. Output Power and T_C



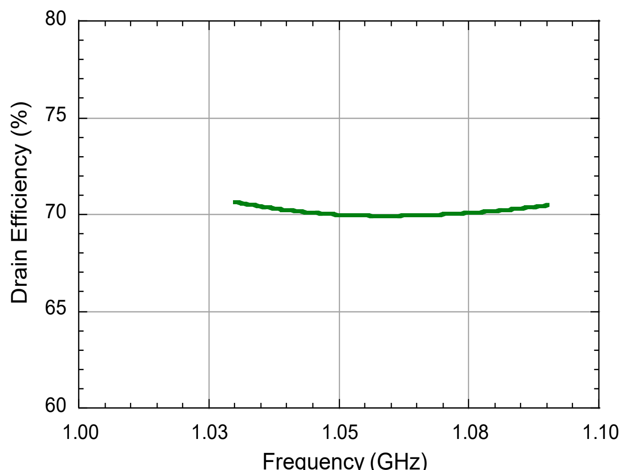
Drain Efficiency vs. Output Power and T_C



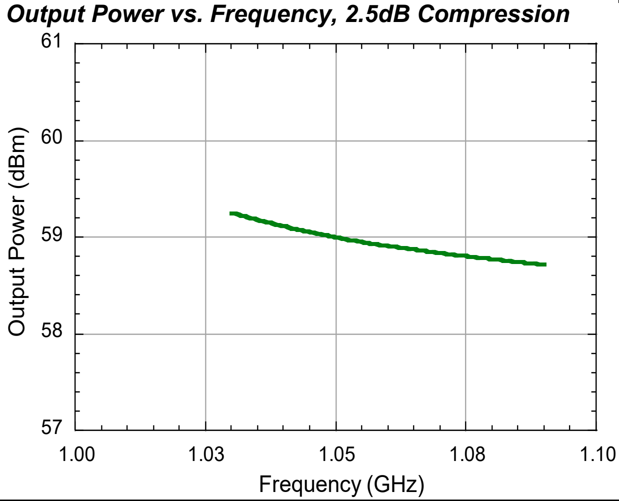
Gain vs. Frequency, 2.5dB Compression



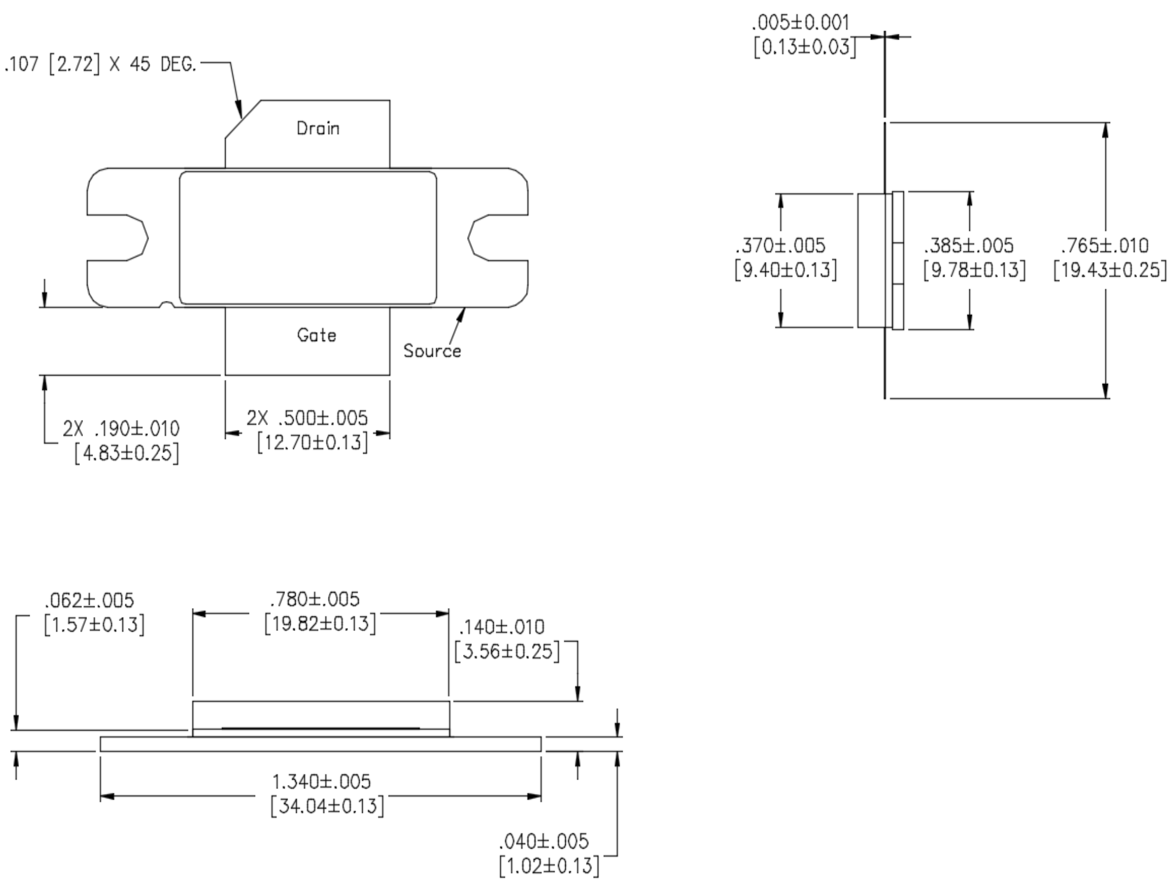
Drain Efficiency vs. Frequency, 2.5dB Compression



Output Power vs. Frequency, 2.5dB Compression



Lead-Free AC-780B-2 Ceramic Package Dimensions†



NOTES:
1. ALL DIMENSIONS SHOWN AS in[mm]. CONTROLLING DIMENSIONS ARE IN in AND CONVERTED mm DIMENSIONS ARE NOT NECESSARILY EXACT.
2. LEAD FINISH: AU
FLANGE FINISH: AU
3. LID SEAL EPOXY MAY FLOW OUT A MAXIMUM OF .018 [0.46] FROM EDGE OF LID
4. LID MAY BE MIS-ALIGNED UP TO .008 [0.20] FROM PACKAGE IN ANY DIRECTION

† Reference Application Note AN0004363 for mounting recommendations.
Meets JEDEC moisture sensitivity level 3 requirements.
Au plating on flange and leads.